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Using GRACE and altimetry to assess the regional sea level budget in the Indian Ocean and Bay of Bengal

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There are a variety of factors driving present-day sea level rise. On one hand, mass loss from Greenland, Antarctica, and the world's glaciers, cause regionally varying sea level increase. While on the other hand, volumetric expansion due to ocean heating, induce long term trends as well as short term fluctuations. In addition, internal ocean mass fluctuations, and vertical land motion play a considerable role on regional to local scales. On such scales, quantifying the regional sea level budget is more challenging compared to the global average, due to increased errors and complex coastal processes. A combination of GRACE gravimetry and radar altimetry allows the separation of the volumetric contribution from the mass contribution.
Here, we also resolve for a finer separation into the various contributions (Greenland, Antarctica, etc.), which requires a more sophisticated approach. We use a simultaneous inversion of GRACE and satellite altimetry data over the years 2002-2014, to separate the sea level budget in the Indian Ocean. For this means, known spatial patterns for the different contributions are prescribed while their individual time variations are estimated from the data. Characteristics of sea level variations in the Indian Ocean (total trend of 3.8 mm/yr) are compared with the global mean sea level budget (2.7 mm/yr). The Bay of Bengal will then serve as an example for a further regionalization of the inversion approach. We find a total sea level in the Bay of Bengal region ranging from 3.8 mm/yr to 5.8 mm./yr, depending on the chosen averaging area and inversion set up. The contributions from the ice sheets and glaciers stand at 1.5 mm/yr, whereas terrestrial hydrology has a negative contribution of about -0.3 mm/yr. The most variable contribution is caused by steric effects whose trend ranges from 1.5 to 3 mm/yr.